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(19)

(54) BITUMINOUS MATERIAL FOR MAKING ROAD SURFACES

(71) We, WOLFF & MULLER, a Kommanditgesellschaft organised under the laws of Germany, of Schwieberdingerstr., 107, D-700 Stuttgart, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a bituminous material for use in making surfaces for roads and the like, particularly surfaces of asphaltic concrete.

Generally, asphaltic concrete road surfaces consist of crushed stone, sand, fillers and a binder. As a rule, bitumen is used as the binder.

The materials are mixed and applied to the road bed, whereupon the applied surface is consolidated by using suitable rollers.

It is also known for road surfaces to be made by using poured asphalt which, after being mixed in heated containers, is conveyed to the site where it is poured.

Of late, in the making of road surfaces, thin coatings of asphaltic concrete have been used, their thickness being less than that of conventional road surfaces. The binder used here is a very soft bitumen, e.g. bitumen B 200. It has been found that the adhesive strength of these thin coatings is inadequate, despite the use of a soft bitumen, which has resulted in these thin coatings being partially destroyed after a relatively short period of use.

In order to improve the adhesive strength of these thin coatings, a binder comprising 40 to 50% by wt. tar oils, 2 to 5% by wt. naphthalene, 2 to 5% by wt. anthracene, 1 to 2% by wt. phenols, 3 to 8% by wt. polyamines and the remainder pitch or asphalt, and marketed under the trade name Prosable, has been admixed with the bitumen.

By the addition of this binder to the bitumen, it has been possible to achieve the desired improvement in the adhesive strength of the aforementioned thin coatings.

In the case of road surfaces made from both asphaltic concrete and also poured asphalt, every endeavour is made to achieve definite values for resistance to deformation and abrasion. It has been found that particularly the abrasion resistance of poured asphalt is superior to that of asphaltic concrete. However, road surfaces made from poured asphalt are more expensive than those from asphaltic concrete, since the mechanical equipment necessary for laying is substantially more expensive and also more comprehensive than in the case of asphaltic concrete, particularly since the poured asphalt is poured in the liquid state in situ, so that it is necessary therefore to convey the material to the site in special heated containers and, until it is poured, to maintain it at a predetermined temperature which is considerably higher than in the case of asphaltic concrete.

Attempts have been made, then, to increase the strength of asphaltic concrete road surfaces by using a hard bitumen, i.e. one having a penetration, according to German Standard DIN 1995, no greater than $80^{1}/_{10}$ mm., e.g. bitumen B 45 or B 60, as the binder. However, it has been found that an asphaltic concrete produced with such a bitumen binder could be worked only with difficulty, was difficult to compact and furthermore, did not produce the resired results.

Therefore, the invention is based on the problem of providing a material for use in making road surfaces and the like which is both easily laid and also has a high resistance to deformation and a high degree of resistance to wear and tear.

According to the invention, this is achieved by a bituminous material comprising a mixture of a hard bitumen (as herein defined) and an additive comprising 40 to 50% by wt. tar oils, 2 to 5% by wt. naphthalene, 2 to 5% by wt. anthracene, 1 to 2% by weight. phenols, 3 to 8% by wt. polyamines, the remainder being pitch or tar.

Expediently, the proportion of the parts of additive to bitumen is from 1:10 to approximately 1:3 by weight.

Preferably, the additive comprises 10 to 15% by weight of the material. A material for surfacing roads preferably comprises a

mixture of crushed stone, sand, fillers and 7 to 8% by weight of a binder comprising the aforesaid bituminous material, the bituminous material preferably comprising 9 parts by weight bitumen B 45 and 1 part by weight additive.

It is ideal for the road surfacing material to comprise 65 parts by weight crushed gravel, 24 parts by weight sand, 10 parts by weight limestone, 1 part by weight asbestos and 7.4 to 7.8 parts by weight of the aforesaid bituminous material.

The invention will be described in greater detail hereinafter with reference to examples.

Test 1.

The effect of the additive on the bitumen was investigated. The bitumen used in this case was bitumen B 80 and bitumen B 45 while the additive comprised 50% by wt. tar oil, 3% by wt. naphthalene, 3% by wt. anthracene, 1.5% by wt. phenols, 5% by wt. polyamines and the remainder pitch. The penetration and softening were measured for various proportions of mix according to DIN 1995. The following Tables I and II show the corresponding values for bitumen B 80 (Table I) and bitumen B 45 (Table II).

TABLE I (B 80)

Test No.	Bitumen content % by wt.	Mixture 1:n additive: bitumen	Penetration (1/10mm)				Softening point Ring and ball (°C)		
			1	2	3	mean	1	2	mean
1	100.0	—	78	79	80	79	49.0	48.6	48.8
2	88.9	1:8	199	190	202	197	38.2	38.8	38.5
3	87.5	1:7	220	216	224	220	38.5	38.0	38.3
4	85.7	1:6	260	266	256	261	38.0	38.2	38.1
5	83.3	1:5	302	296	304	301	37.6	38.0	37.8
6	80.0	1:4	352	360	362	358	34.2	35.0	34.6
7	75.0	1:3	380	403	401	395	32.2	33.0	32.6
8	66.7	1:2	422	433	405	420	28.8	29.0	28.9

TABLE II (B 45)

Test No.	Bitumen content % by wt.	Mixture 1:n additive: bitumen	Penetration (1/10mm) 1	2	3	mean	Softening point Ring and ball (°C) 1	2	mean
1	100.0	—	44	37	30	37	58.8	58.8	58.8
2*	100.0	—	35	35	34	35	—	—	—
3	90.0	1:9	107	102	97	102	48.8	48.8	48.8
4*	90.0	1:9	84	83	77	81	—	—	—
5	88.9	1:8	133	128	136	132	46.4	47.0	46.8
6*	88.9	1:8	114	121	116	117	—	—	—
7	87.5	1:7	141	132	142	138	4.4	44.5	44.5
8	85.7	1:6	183	188	182	184	42.6	42.8	42.7
9	83.3	1:5	183	184	186	184	41.2	41.0	41.1
10	80.0	1:4	190	190	195	192	40.8	41.0	40.9
11*	80.0	1:4	180	177	178	178	—	—	—

* Penetration after the mixture investigated had been heated again.

As Table I shows, for bitumen B 80 the penetration of approximately 8 mm with pure bitumen increases to approximately 40 mm with 25 to 34% by wt. additive, while the softening point of approximately 49°C for pure bitumen dropped to approximately 32°C with 25% by wt. additive and to approximately 29°C with approximately 34% by wt. additive.

Table II shows that with a very hard bitumen B 45 the penetration rose from approximately 3.7 or 3.5 mm respectively for pure bitumen to approximately 18 to 19 mm, for a proportion of approximately 20% by wt. additive. The softening temperature drops from approximately 59°C for pure bitumen to approximately 41°C for approximately 20% by wt. additive.

The Tables show that by adding the additive the hard bitumen is made softer and thus more easily worked. For example, by the addition of approximately 12% by wt. additive to bitumen B 45, it is possible to obtain more or less the penetration and softening of a bitumen B80, while an addition of approximately 15 to 20% by wt. additive to bitumen B 45 results in more or less the properties of bitumen B 200.

In the case of bitumen B 80, a drop in softening point of approximately 1 to 2°C was obtained for an addition of in each case of 2% by wt. additive. In the case of bitumen B 45, this drop in softening point is even more clearly marked and in some cases reaches approximately 3°C for an addition of 2% by wt. additive.

It is evident from Tables I and II that hard bitumen such as particularly B 45 and also B 80 can be so altered in its properties by the addition of the additive according to the invention that the softening point drops while the penetration rises.

This has the result that an asphaltic concrete mixture in which the bituminous material according to the invention is used as the binder, can be worked and compacted substantially more easily than for example when pure B 45 or pure B 60 is used. In actual fact, the mixture produced in this way can be processed just as unproblematically as an asphaltic concrete mixture using as the binder a substantially softer bitumen, e.g. bitumen B 200.

Surprisingly, however, it has been found that in the case of road surfaces of asphaltic concrete, using as a binder the bituminous material according to the invention (e.g. bitumen B 45 or B 60 plus additive), the resistance to deformation and abrasion, i.e. generally speaking the resistance to wear and tear, could be substantially enhanced, whereby the values for poured asphalt were attained, as demonstrated by the following test.

Test 2.

A mineral mixture of the following composition was used:

35 parts by weight crushed gravel of an average particle size of 8—12 mm.

15 parts by weight crushed gravel of an average particle size of 5—8 mm.
15 parts by weight crushed gravel of an average particle size of 2—5 mm.
12 parts by weight crushed sand
12 parts by weight natural sand
10 parts by weight limestone filler
1 part by weight asbestos.

To this mineral mixture were added, as a binder, 7.4/7.8 parts by weight bituminous material consisting in turn of 9 parts by weight bitumen B 45 and 1 part by weight of the additive in accordance with the invention.

From this mixture, test specimens were prepared by the Marshall method and tested according to DIN 1996, sheet 13 (impression test using a plane die). In contrast to the requirements of DIN 1996, however, during the subsequent tests A and C, the test specimens were compacted with only 25 impacts instead of 50 as prescribed in DIN 1996.

The results of this test are shown in the following Table:

TABLE III

	Stand time	1	2	mean
A: 7.4% bitumen	15 min.	98		
at 40°C	20 min.	111		
in 1/100 mm	25 min.	120		
25 impacts	30 min.	123		
B: 7.4% bitumen	5 min.	112	146	129
at 40°C	10 min.	120	156	138
in 1/100 mm	15 min.	125	163	144
50 impacts	20 min.	128	167	148
	25 min.	130	170	150
	30 min.	132	172	152
	35 min.	133	174	154
	40 min.	134	176	155
C: 7.8% bitumen	5 min.	158	162	160
at 40°C	10 min.	181	186	183
in 1/100 mm	15 min.	193	198	195
25 impacts	20 min.	202	206	204
	25 min.	209	212	210
	30 min.	215	217	216
	35 min.	220	221	220
	40 min.	224	225	224

TABLE III contd.

	Stand time	1	2	mean
D: 7.8% bitumen	5 min.	132	148	140
at 40°C	10 min.	143	161	152
in 1/100 mm	15 min.	149	168	159
50 impacts	20 min.	153	173	163
	25 min.	156	176	166
	30 min.	158	179	169
	35 min.	160	181	171
	40 min.	162	183	172

The technical specification "Bituminous Road Building 6/60" requires for poured asphalt at a temperature of 40°C a loading time of 30 minutes and a compaction with 50 impacts, an indentation of 1 to 6 mm for passing traffic and 1 to 4 mm for standing traffic.

As the Table shows, for these specifications, test A shows an indentation of 1.23 mm; in the case of test B an indentation of 1.52 mm; in the case of test C an indentation of 2.16 mm and in the case of test D an indentation of 1.69 mm.

A comparison shows that the figures required for poured asphalt are satified in both cases by all the test specimens investigated, in fact even when, as is in tests A and C, the test specimens were compacted with only 25 impacts.

An investigation of the cavity content or spatial density revealed that a compaction of 99.2% was achieved already at 25 impacts.

Thus, the invention makes it possible to produce road surfaces of asphaltic concrete, the strength properties of which approximate those of poured asphalt, whereas they can be laid more rapidly and easily and with less mechanical expenditure than in the case of poured asphalt.

WHAT WE CLAIM IS:—

1. A bituminous material for use in making surfaces for roads comprising a mixture of hard bitumen (as herein defined) and an additive comprising 40 to 50% by wt. tar oils, 2 to 5% by wt. naphthalene, 2 to 5% by wt. anthracene, 1 to 2% by wt. phenols, 3 to 8% by wt. polyamines, the remainder being pitch or asphalt.

2. A bituminous material according to Claim 1, wherein the additive comprises 50% by wt. tar oil, 3% by wt. naphthalene, 3% by wt. anthracene, 1.5% by wt. phenols, 5% by wt. polyamines, the remainder being pitch.

3. A bituminous material according to Claim 1 or 2, wherein said bitumen is bitumen B 45 or B 60.

4. A bituminous material according to any one of Claims 1 to 3, characterised in that the proportion by wt. of additive to bitumen is in the range from 1:10 to 1:3.

5. A bituminous material according to any preceding claim, characterised in that the additive comprises from 10 to 15% by wt. of the material.

6. A material for surfacing roads, comprising a mixture of crushed stone, sand, fillers and 7 to 8% by wt. of a binder comprising a bituminous material according to any one of Claims 1 to 5.

7. A material according to Claim 6, characterised in that it comprises 65 parts by weight crushed gravel, 24 parts by weight sand, 10 parts by weight limestone, one part by weight asbestos and 7.4 to 7.8 parts by weight bituminous material.

8. A material according to Claim 6 or 7, characterised in that the bituminous material comprises 9 parts by weight bitumen B 45 and one part by weight additive.

9. A bituminous material according to Claim 1 for use in making surfaces for roads, substantially as hereinbefore described with reference to the Examples.

10. A material according to Claim 1 for surfacing roads, substantially as hereinbefore described with reference to the Examples.

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